MV 4

TA-2

INSTRUCTION MANUAL

FOR THE

STARK

"VOHMASTER"

MODEL TA-2

ELECTRONIC

VOLT-OHM-CAPACITY-INDUCTANCE-MILLIAMETER

STARK

STARK ELECTRONIC INSTRUMENTS LIMITED

STARK BUILDING - AJAX, ONT.

11952

200-7-58-D.Co.Ltd.

STARK ELECTRONIC INSTRUMENTS LIMITED manufacture a complete line of Electrical Indicating Meters, Tube Testers, Circuit Analyzers, and Signal Generators, in sizes and ranges to suit every purpose.

TUBE TESTERS are modern and up-to-date, accurate, and easily operated.

CIRCUIT ANALYZERS can be had in many designs from the handy pocket size to large de-luxe models. They cover an extremely wide range of all electrical measurements.

ELECTRICAL INDICATING METERS incorporated in Stark Tube Testers and Circuit Analyzers are completely manufactured in our own plants.

All meter needs for AC or DC voltage and current measurements, both Panel Mounting and Portable, can be supplied in five distinctive styles, in round or rectangular, from 2" to 9" sizes.

See inside back cover for further details.

NOTE

WHEN MAKING ENQUIRIES PERTAINING TO THIS INSTRUMENT, PLEASE PROVIDE THE SERIAL NUMBER AS WELL AS THE MODEL NUMBER.

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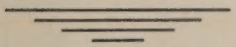

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GUARANTEE

Stark Test Equipment is guaranteed against inaccuracy or defect in material or workmanship for a period of 90 days after date of shipment from our factory. Adjustment under terms of this guarantee will be made by the factory or our repair station without charge. This guarantee does not cover transportation charges to or from our factory or repair stations.

This guarantee expressly does not cover vacuum tubes of any description which are shipped within, or as accessories to, any instrument. (These tubes are guaranteed by the tube manufacturer.)

WARNING

Caution: Do not attempt to measure over 300 volts A.C., using the probe, as this is liable to damage the 6AL5 rectifier tube in the probe.

The probe housing is operated at the same potential as the chassis of the instrument; therefore, the same precaution should be observed in touching the probe housing, in respect to any electrical connection, that would be observed in touching the instrument itself.

RETURNING EQUIPMENT FOR REPAIR

See "PRELIMINARY CHECKS FOR OPERATION" – Section 2

Before returning any equipment for service, under warranty or otherwise, the factory must first be contacted giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Address all service inquiries to Stark Electronic Instruments Ltd., Ajax, Ontario.

GUARANTEE CARD

The above guarantee is contingent upon the guarantee card being returned to the factory immediately upon receipt of the equipment.

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OPERATING INSTRUCTIONS FOR STARK MODEL TA-2 ELECTRONIC VOLT-OHM CAPACITY MILLIAMMETER

TECHNICAL DATA SHEET

EQUIPMENT SUPPLIED

QUANTITY	NAME	DIMENSIONS
1	Electronic Volt-ohm Capacity Milliammeter TA-2	8½" x 11" x 6"
1	Instruction Book	
1	Test Lead - Red	48"
1	Test Lead - Black	48"
1	A.C. Probe Assembly	48"
1	D.C. Cable Assembly	48"

TECHNICAL CHARACTERISTICS

1. **Power Supply:** 105 – 125 volts 60 cycles
   or 105 – 125 volts 25 cycles
   or 210 – 250 volts 50 cycles
   depending on markings specified on the panel.

2. **Power Consumption:** 25 watts at specified voltage and frequency.

3. **Scales:**
   (a) VOLTS MILS: 0 – 3 0 – 12
   (b) 0–3 VOLTS A.C. ONLY: 0 – 3
   (c) OHMS: 0 – 10,000 – inf.
   (d) CAPACITY: MMF 0 – 1000 – inf.)
   MF 0 – 10 – inf.) 50–60 cycles*
   (e) VOLTS: Zero Centre D.C.

   ** For 25 cycle capacity tests use conversion chart.*

4. **Ranges:**

(a) Volts, A.C. RMS:	0 – 3, 12, 30, 120, 300, 1200
(b) Volts, A.C. Peak to Peak	0 – 3, 12, 30, 120, 300
(c) Volts, D.C.:	0 – 3, 12, 30, 120, 300, 1200
(d) Mils. D.C.:	0 – 3, 12, 30, 120, 300, 1200
(e) Capacity:	0 – 10,000 mmf. in two ranges
	0 – 1000 mf. in five ranges
	50 mh – 100 henries *(use conversion chart)*
(f) Ohms:	1 ohm to 10,000 megohms, in eight ranges

5. **Frequency:** AC to over 100 megacycles may be measured.

6. **Accuracy:** 2% of full scale deflection for D.C.
3% of full scale deflection for A.C.
5% of full scale deflection for 0 – 3 Volts A.C. range.
3% of centre scale and proportional accuracy to the right of centre scale of ohms.
3% of centre scale and proportional accuracy to the left of centre scale for capacity.

7. **Meter:** STARK model 606 500 Microamperes, 2300 ohms.

8. **Tube Complement:**

TUBE TYPE	FUNCTION
6 x 5 GT	A.C. Power Rectifier
VR 150	Voltage Regulator
6 x 5 GT	A.C. Input Rectifier
6 SN 7	Vacuum Tube Voltmeter
6 SJ 7	Cathode Follower
6 AL 5	High Frequency Input Rectifier

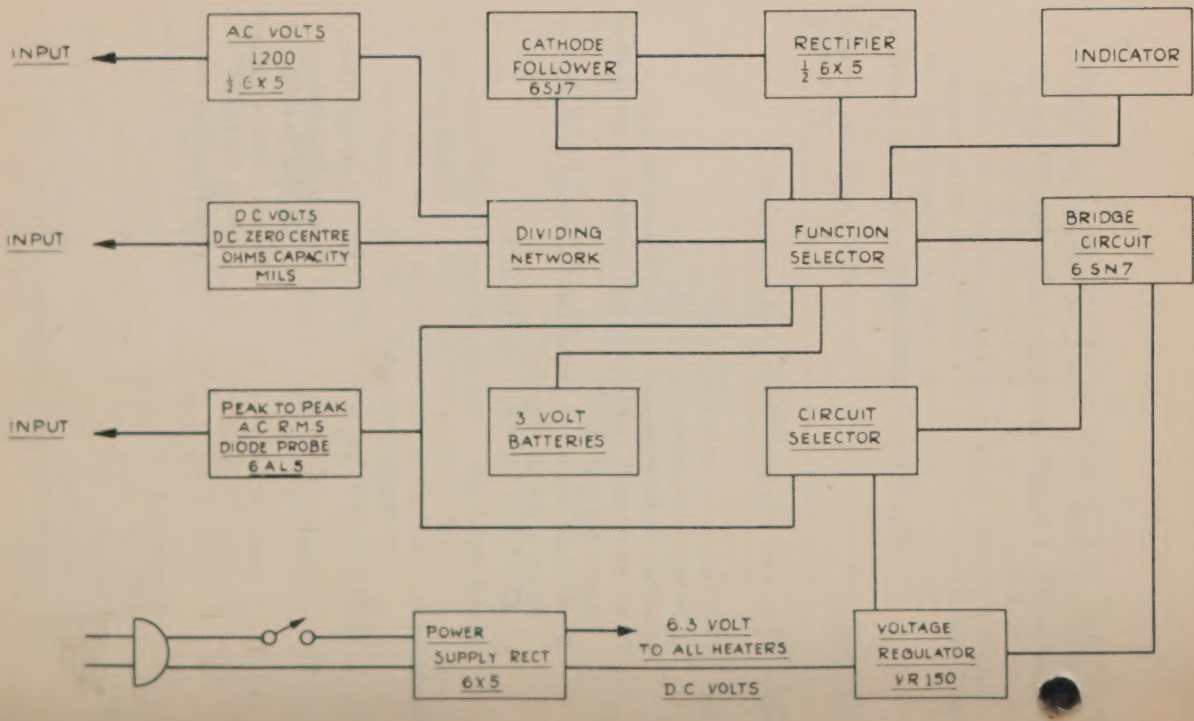


FIGURE 12 - BASIC DIAGRAM IN BLOCK FORM MODEL TA-2

SECTION 1 – DESCRIPTION

1.1 PURPOSE

The [redacted]k Electronic Volt-ohm-Capacity-Milliammeter, Model TA-2 described herein, is a practical, universal test instrument which may be used in making measurements in the study and repair of radio, electronic and television circuits. It is a versatile instrument, as the measurements of wide ranges of D.C. Currents, A.C. and D.C. Voltages, resistances, capacitances and inductances, may be made by one unit. Built under Stark high standards of workmanship, it is an accurate and durable test instrument.

1.2 DESCRIPTION

(a) Physical

The instrument is enclosed in a steel case, 8½" x 11" x 6", with a handle at the top and feet on two sides so that the instrument may be used in either a horizontal or vertical position. The chassis is mounted on the front panel and is accessible by removing the eight screws holding the panel to the case and then removing the panel. The meter is accurately calibrated with the scales clearly marked. A mechanical adjustment of the zero setting is provided on the front of the meter. A diode probe and shielded cable are provided for A.C. voltage measurements and is attached to the unit by means of a four contact connector. A D.C. isolating probe (shielded) is provided for D.C. voltage measurements. Two additional leads are supplied for all other measurements. All switches, connectors and controls are clearly marked on the front panel. A pocket is provided on the side of the case to be used for storage purposes. Sturdy "Five Way" binding posts are provided for inserting the test leads into the desired circuit.

(b) Components

The following leads, as shown in Figure 1.3, are furnished with the Model TA-2.

(1) An A.C. probe and shielded cable assembly is furnished for making A.C. voltage measurements to 300 volts. This cable is 48" long with a four contact connector on one end and the probe on the other. The circuit of this probe is shown on the schematic diagram, Figure 7.1.

(2) A 48" shielded test lead with an isolating resistor incorporated into the probe is supplied for making all D.C. voltage measurements. This lead has a test prod on one end and a microphone type connector on the other.

(3) Two unshielded test leads, 48" long, are supplied for making all resistance, capacity, inductance and current measurements. The leads

have test-prods on one end and sturdy banana plugs on the other, for insertion into the end of the binding posts. An alligator clip is supplied for making convenient ground connections.

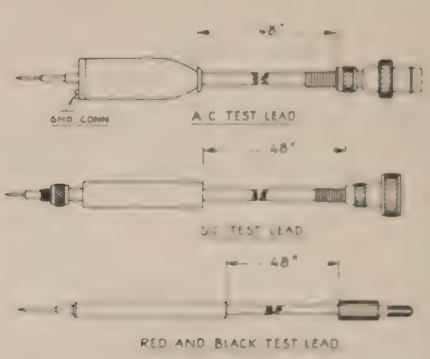


FIGURE 1.3 - TEST LEADS

(c) **Functional**

The Model TA-2 is designed to perform the following electrical functions:

(1) To measure a wide range of D.C. currents and voltages, A.C. volts in terms of RMS or peak-to-peak value, resistances, capacitances and inductances.

(2) To measure A.C. voltages accurately over a wide range of frequencies.

(3) To provide a minimum loading effect to the circuit under test, thereby ensuring greater accuracy.

(4) To have a meter circuit design which will eliminate the possibility of damage to the meter from overload. (milliammeter circuit excepted).

(d) **Electrical**

(1) The power supply circuit is of the voltage regulated type, consisting of a transformer, rectifier, filter and a voltage regulator tube. D.C. voltage needed for ohmmeter measurements is supplied by two 1½ cells in series, also incorporated in the instrument.

(2) Three separate voltage divider networks are used in the input circuit, one for current measurements, one for resistance and capacitance measurements, and one for A.C. and D.C. voltage measurements. The

FUNCTION SELECTOR switch, in conjunction with the CIRCUIT SELECTOR, determines which network is to be used, and the RANGE switch determines the position within the network. A switching arrangement has been incorporated so that voltages, either positive or negative with respect to ground may be measured merely by operating the switch to the correct D. C. position, rather than by reversing the position of the leads themselves. A D.C. volt zero center position is also incorporated for measuring potentials for a null balance.

(3) In measuring D.C. currents, the unknown is applied directly to the meter with its parallel shunt network. In D.C. voltage measurements, the input is placed across the proper voltage dividing network from which the correct portion for a given range is applied to the grid circuit of a vacuum tube bridge circuit. In A.C. voltage measurements the input is rectified in the diode probe before being placed across the divider network. In A.C. peak to peak measurements, the input is rectified by a voltage doubler circuit before being applied to the divider network. In resistance measurements the unknown is placed in series with an internal source of D.C. voltage and a portion of the divider network, depending on the range used. The voltage drop across the unknown is applied to the grid of the bridge circuit. In capacitance and inductance measurements, the unknown is placed in series with a source of A.C. voltage and a portion of the divider network. The A.C. voltage drop across the unknown is applied to a cathode follower, the output of which is rectified by electronic means, and then impressed on the grid of the bridge vacuum tube.

SECTION 2 – PRELIMINARY CHECKS FOR OPERATION

2.1 GENERAL

(a) Before attempting to make any specific measurements with the Model TA-2 the following steps should be taken to see whether or not the instrument is functioning properly in all respects.

(1) Make a visual inspection of the unit to see that it has not been damaged in shipment. Be sure that all test leads are with the unit. Refer to Figure 1.3, Test Leads. Observe whether or not the indicator is at zero. To reset the zero, turn the mechanical adjustment on the indicator with a screwdriver. Plug the unit into the A.C. line and operate the power switch to "ON". The pilot light should indicate that the power is on. Refer to panel marking for proper power source.

(2) After a one minute warm-up, turn SELECTOR to A.C. VOLTS and the FUNCTION SELECTOR to NORMAL. Set the RANGE SELECTOR to 3 VOLTS. Adjust the Zero Adjust control until the indicator comes to zero.

(3) Turn SELECTOR to +D.C. and –D.C. respectively. The indicator should stay approximately at zero.

(4) Turn SELECTOR to OHMS. The indicator should go toward full scale. The Ohms Capacity Adjust should be capable of adjusting the indicator to exactly full scale.

(5) Turn FUNCTION SELECTOR to CAP. The indicator should stay approximately at full scale. Adjust OHMS-CAP. to full scale.

(6) Turn FUNCTION SELECTOR to MILS. The indicator should go to zero.

(7) Rotate SELECTOR back to A.C. VOLTS. Turn FUNCTION SELECTOR to Peak-To-Peak and adjust to zero with the Zero Adjust Control.

(8) ROTATE SELECTOR to +D.C. Rotate SELECTOR switch to D.C. ZERO CENTER. The indicator should go approximately to center scale. Use the Zero Adjust Control to adjust to exactly zero center.

(b) If, in any event any of the above checks are not normal, the factory should be contacted, giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Address all service enquiries to – Stark Electronic Instruments Limited, Ajax, Canada.

SECTION 3 – THEORY

3.1 GENERAL:

A thorough understanding of the theory behind the operation of any instrument will enable the user to obtain greater utility and satisfaction from the instrument. For this reason the following brief explanation of the circuit of the Stark Volt-ohm-capacity-Milliammeter Model TA-2 is given. As the principles of operation rather than detailed explanation of the operation is intended, the full schematic shown in Figure 7.1, is greatly simplified. The power supply incorporated in the unit is a conventional voltage regulated type employing a transformer, full-wave rectifier, filter and regulator tube, therefore no explanation of it is given. The Milliammeter circuit, as shown in Figure 3.2 also needs no detailed explanation, as it is simply

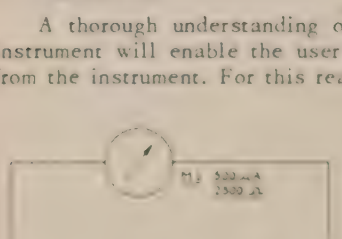


FIGURE 3.1 MILLIAMETER CIRCUIT

a meter shunted by a resistance network whose value is determined by the range of the current to be measured.

3.2 BRIDGE CIRCUIT

The bridge circuit is common to all measuring circuits except the milliammeter section. Specific application of the bridge is given in the type of measurement to be performed, i.e. resistance, capacitance or voltage.

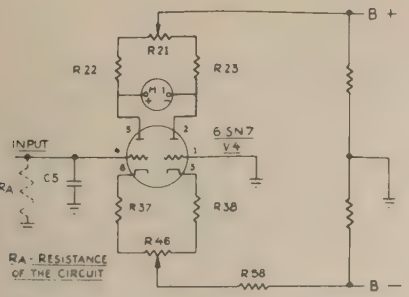


FIGURE 3.2 - BASIC BRIDGE CIRCUIT

The basic circuit of the bridge is similar to the common Wheatstone bridge in operation. Voltage is applied across the bridge; B + at R21 and B – through resistor R58 to R46. R21 acts as the zero adjustment and is adjusted so that with no voltage applied to either grid of the tube, the meter reads zero, indicating balance between the two triodes of the twin triode used as the bridge tube. When making all measurements, except capacity measurements, the grid of one triode remains at ground potential, and the grid of the other triode changes to a potential determined basically by the unknown being measured. Changing the potential on only one of the grids will unbalance the bridge and cause a deflection of the meter in direct proportion to the change in grid potential, as the plate current changes with grid potential. The Meter has a calibrated scale which interprets this deflection in terms of volts, ohms, or units of capacity, so that in conjunction with the RANGE SWITCH, the unknown can be evaluated directly from the scale reading. This is basically the action of the bridge and meter. The type of measurement to be made will determine both the input grid to be used and the method of obtaining the input voltage.

3.3 A. C. VOLTMETER

(a) **Normal Position.** With reference to Figure 3.3 and the switch in the normal position, the A.C. voltage to be measured is rectified by one-half of the 6AL5 twin diode and the resultant D.C. voltage is applied to the divider network. Part of this voltage, as determined by the position of the RANGE switch, is fed to one of the grids of the bridge tube causing the bridge circuit to function. In this normal position the instrument is calibrated to read in terms of RMS voltages of a sine wave.

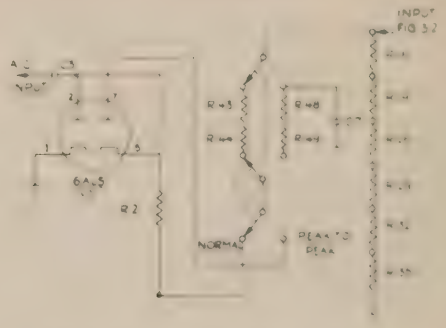


FIGURE 3.3 A.C. VOLTMETER CIRCUIT

(b) **Peak-to-Peak position.** When the switch is operated to the Peak-to-Peak position, and a voltage to be measured is applied to the input, the action of the twin diode and the input and output capacitor will rectify the incoming A.C. voltage and apply it to the divider network. Part of this resultant D.C. voltage will be applied to the grid of the bridge tube, depending on where the RANGE switch is set. In this position the instrument is calibrated in peak-to-peak voltage and is useful in the measurement of non-sinusoidal waveforms.

(c) Negative contact potential is developed across the rectifier tube before any input voltage is applied, due to normal emission of electrons by the cathode. In either position of the switch (normal or peak-to-peak) this negative voltage is applied across the input voltage divider network and would cause the meter to deflect. To compensate for this undesirable deflection, a positive voltage from the B+ supply equal to the contact potential is fed to the voltage divider through a 90 megohm resistor. The A.C. Voltmeter, 1200 volts, with reference to Fig. 3.3a consists of one-half a 6 x 5 diode rectifier. This rectifier voltage is applied to R38 of the voltage divider network and impressed on a grid of the bridge tube circuit.

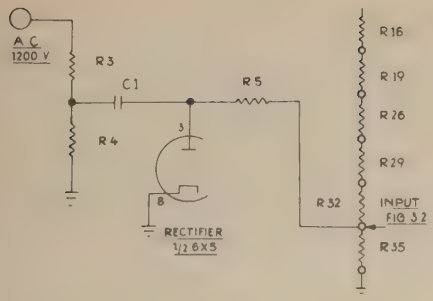


FIGURE 3.3a A.C. VOLTMETER 1200 VOLTS

3.4 D.C. VOLTMETER:

(a) The D.C. input voltage applied to the D.C. Volts and GND connections of the instrument, is applied through a 3.3 megohm resistor in the probe directly to the voltage divider network, as shown. A part of this voltage, as determined by the position of the RANGE switch, is fed to the input grid of one of the triodes of the bridge tube, causing the bridge circuit to function. Deflection of the meter pointer in the wrong direction indicates that the polarity of the voltage being measured is reversed with respect to the polarity of the meter and bridge circuit. A switching arrangement has been incorporated in the instrument, however, which switches the input grids of the bridge tube to permit measurements of either polarity.

(b) Zero Center Position. With reference to Figure 3.2, the Circuit Selector Control is operated to the D.C. Zero Center position and will shunt R22 so that the bridge will become unbalanced to the extent that the meter will indicate at approximately center scale. This is useful for alignment of the discriminator stages of FM and TV receivers.

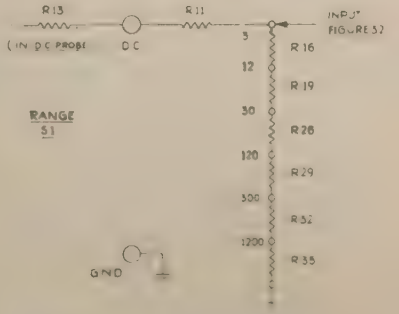


FIGURE 3.4 D.C. VOLTMETER

3.5 OHMMETER

(a) When an unknown resistor is connected across the OHMS-CAP, and GND terminals, it is placed in series with the input voltage divider network, as determined by the Range Control and the dry cells incorporated in the instrument.

(b) The voltage applied to the input grid of the bridge tube is the voltage across the unknown resistance caused by the battery current flow and is proportional to the unknown resistance. The resulting meter deflection can be calibrated in terms of resistance.

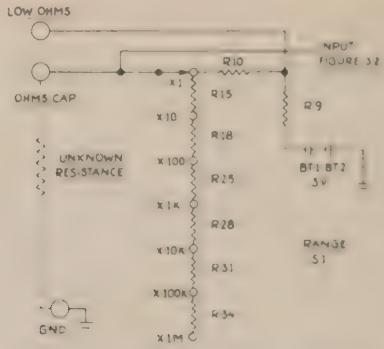


FIGURE 3.5 OHMMETER CIRCUIT

3.6 CAPACITY AND INDUCTANCE MEASUREMENTS:

(a) **Capacity.**

The theory of the capacity measurements is similar to that of the ohmmeter, with the impedance of the unknown capacitor replacing the unknown resistance. However, as an A.C. voltage is needed to measure the capacitance and as only D.C. can be applied to the input grid of the bridge tube, some means must be used to rectify the A.C. The A.C. voltage tapped off the voltage divider network is fed to the grid of a cathode follower which is used in the circuit as an impedance matching device. The cathode output is fed to the rectifier circuit, which consists of V1, a condenser C2, and a resistance R3. The output of the rectifier is fed to the input grid of the bridge tube.

(b) **Inductance:**

The theory of the inductance measurements is similar to that of a

capacitance measurement with the impedance of the inductance replacing that of the capacitor. As the capacity scale is used in making measurements, a chart is given in Figure 5.1 which relates capacity reading to impedances. This impedance, in its effect in the circuit may be due to either an inductance or a capacitor. With the aid of a simple formula, the inductance can be determined.

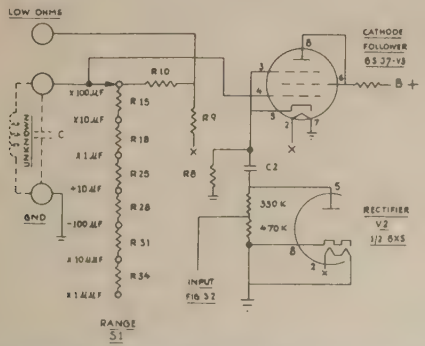


FIGURE 3.6 CAPACITY AND INDUCTANCE MEASUREMENTS

SECTION 4 – OPERATION

CAUTION

The high voltages which can be measured with this instrument may be dangerous to life. Extreme care should be taken to avoid bodily contact with exposed high voltages.

4.1 GENERAL:

(a) To avoid error in resistance, capacity and inductance measurements, be sure that the unknown to be measured is isolated from other circuits. In capacity and inductance measurements, it is advisable to remove the unknown from the circuit entirely. In resistance measurements it is sufficient to free only one terminal of the resistor.

(b) Be sure the instrument is being operated from the correct power source. It is necessary to allow a two or three minute warm-up period so

that stable operation is assured. If the instrument is to be used intermittently over a period of time, it is advisable to keep it turned on to avoid delay.

4.2 A. C. VOLTAGE MEASUREMENTS:

Do not attempt to measure A.C. potentials over 300 volts when using the probe.

(a) Normal Position

(1) Operate the POWER switch to ON.

(2) Connect the A.C. probe to the unit by means of the four prong connector.

(3) Connect the black unshielded test lead to the GND post. If voltages are being measured at frequencies over 50 megacycles, a braided ground connection should be made from the diode probe to the unit being tested. This lead should be as short as possible.

(4) Turn the SELECTOR switch to A.C. VOLTS.

(5) Turn FUNCTION switch to NORMAL.

(6) Turn the RANGE switch to the range which will cover the voltage to be measured. If this is unknown, choose the highest range.

(7) Check the meter for zero setting. Adjust to zero with the ZERO ADJUST control. In setting the meter to zero, do not touch the prod on the A.C. probe as the stray pickup will deflect the meter.

(8) Connect the A.C. probe and the black test lead to the voltage to be measured.

(9) Read the numerical value from the scale directly and apply the multiplying factor for the position of the RANGE switch.

(b) Peak-to-Peak:

Do not attempt to measure over 500 volts peak-to-peak.

(1) Procedure for A.C. measurements is identical to that outlined in paragraph 4.2a, with the exception of Step 5 which, in this case, should be changed to "Peak-to-Peak".

(c) 1200 Volts A.C.

(1) Connect red test lead to the 1200 VOLT post.

(2) Connect black test lead to the GND post.

(3) Turn SELECTOR switch to VOLTS A.C.

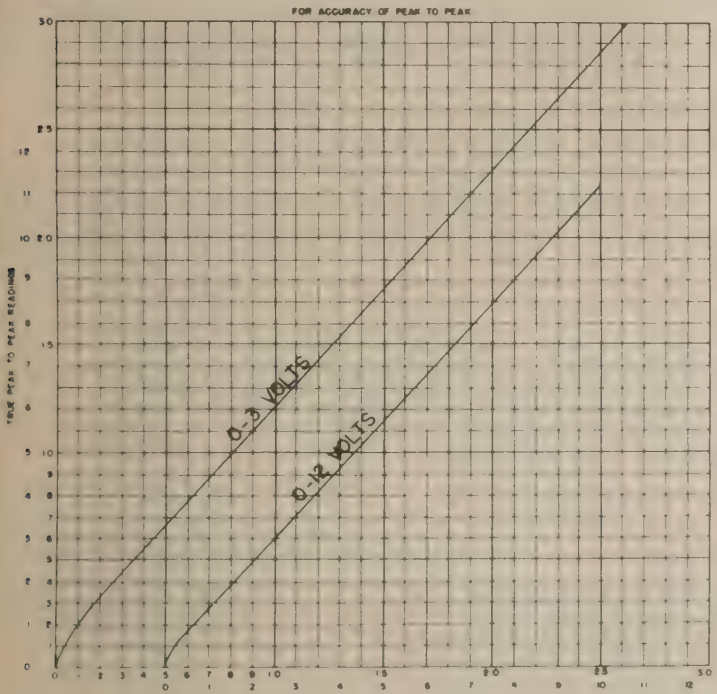
(4) Turn FUNCTION switch to NORMAL.

(5) Turn RANGE switch to 1200 volts.

(6) Check meter for zero setting and adjust to zero with the ZERO ADJUST control.

(7) Connect the red and black leads to the voltage to be measured.

(8) Read voltage directly from the scale.



4.3 D.C. VOLTAGE MEASUREMENTS:

(a) **Normal:**

(1) Turn the SELECTOR switch to +D.C.V.

(2) Turn the FUNCTION switch to NORMAL.

(3) Turn the RANGE switch to the range which will cover the voltages to be measured. If an approximate range is unknown, choose the highest range.

(4) Check the meter for zero setting at the range at which the

measurement is to be made. Adjust to zero with the Zero Adjust Control.

(5) Connect to the unknown voltage, using the shielded cable with the microphone connector, and the black test lead.

(6) If the meter reads in the wrong direction, operate the SELECTOR switch to –D.C.V.

(7) Read the numerical value from the scale directly and apply the multiplying factor for the position of the RANGE control.

(b) **Zero Center:**

(1) Turn SELECTOR switch to +D.C. Volts.

(2) Turn FUNCTION switch to "Zero Center" position.

(3) Turn RANGE switch to the range which will cover the voltages to be measured. If an approximate range is unknown choose the highest range.

(4) Check meter for zero setting at the range at which measurements are to be made.

(5) Adjust to zero center with Zero Adjust Control.

(6) Connect to unknown voltage using the shielded cable with microphone connector and the black ground lead.

4.4 CURRENT MEASUREMENTS:

(a) To avoid possible injury to the meter, always make measurements using the high range first.

(b) To avoid error due to an inaccurate initial setting of the meter, check the zero setting of the meter before making any measurements. Adjust the zero setting mechanically by means of the screwdriver adjustment in the front of the meter, if necessary.

(c) Turn the SELECTOR switch to MILLS.

(d) Turn the RANGE switch to the range which will cover the currents to be measured. If an approximate range is unknown, choose the highest range.

(e) Connect to the unknown using the black ground lead for –MILLS and the red for +MILLS.

(f) Read the numerical value from the scale directly and apply the multiplying factor for the position of the RANGE switch.

4.5 RESISTANCE MEASUREMENTS:

(a) Turn the SELECTOR switch to OHMS.

(b) Turn the FUNCTION switch to NORMAL.

(c) Turn the RANGE switch to the range which will cover the resistance to be measured. If it is desired to use the LOW OHMS scale, turn the RANGE switch to the X1 position.

(d) Connect the red and black leads to the OHMS-CAP. and GND posts respectively. When using the LOW OHMS scale, connect the leads to the LOW OHMS and GND posts. Adjust the meter to zero with the ZERO ADJUST Control while shorting the test leads together. Open the leads and adjust the meter to full scale with the OHMS-CAPACITY ADJUST CONTROL.

(e) Connect the unknown resistance between the test leads, making sure it is isolated from any other circuit components which might introduce error.

(f) Read the numerical value from the scale directly and apply the multiplying factor for the position of the RANGE switch. **NOTE: When measuring LOW OHMS read the numerical value from the scale and divide the reading by 10.**

CAUTION

Do not short the lead from the LOW OHMS post to GND. Unless the SELECTOR switch is on the OHMS position, as there is a possibility of burning out resistor R9.

4.6 CAPACITANCE MEASUREMENTS:

(a) Turn the SELECTOR switch to CAP.

(b) Turn the FUNCTION switch to NORMAL.

(c) Turn the RANGE switch to the range which will cover the capacity to be measured.

(d) Connect the red and black leads furnished to OHMS CAP, and GND respectively, and check the zero setting by shorting the leads together. Adjust zero with the ZERO ADJUST control. Open the leads and check for full-scale deflection. Adjust to full scale with the OHMS-CAPACITY ADJUST control.

(e) With the exception noted below, connect to the capacitor to be measured using the red and black leads furnished. The capacitor should be disconnected from its associated circuit in making this measurement.

IMPORTANT

Since the capacity measuring circuit is exceedingly sensitive on the two lowest capacity ranges (X1 and X 10 mmf) the test leads will pick up any stray A.C. voltage fields near the leads. This will generally cause the

meter to read off-scale to the right, which results in erratic readings. It is therefore advisable to connect the capacitor under test directly to the OHMS CAP and GND. posts when using either of these two ranges.

NOTE

Since the instrument has an appreciable internal capacity of 30-40 mmf., the meter, when turned to the X1 mmf. range, will read this capacity. Be sure to adjust the indicator to full scale with the OHMS-CAPACITY ADJUST control when on some range other than the X10 or X1 mmf., even though it is known that one of these ranges will be used in actual measurement. Do not readjust this control when changing to these ranges, but note the reading on the indicator before the unknown capacity is connected. Then subtract this reading from the reading with the capacitor connected to obtain the true capacitance of the unknown.

(f) Multiply the numerical value indicated on the scale by the multiplying factor indicated by the RANGE switch. In cases where it is necessary to use the X1 and X10 mmf. ranges, the true value of the unknown will be the difference between the meter readings with and without the capacitor connected.

(g) **Capacity measurements when used on other than 60 cycle supply:**

A simple conversion factor may be used to convert capacity readings for other than 60 cycle operation. This formula is as follows:

$$CA = \frac{CM\ 60}{f}$$

Where CA = Actual Capacity
CM = Measured Capacity
F = Line supply frequency

In the case of 25 cycles, the above formula could be reduced to CA = 2.4 CM

4.7 INDUCTANCE MEASUREMENTS:

(a) Turn the SELECTOR switch to CAP.

(b) Turn FUNCTION switch to NORMAL.

(c) Turn the RANGE switch to X100 MFD.

(d) Insert the red and black test leads into the posts marked OHMS CAP. and GND and check the zero setting by shorting the leads together. Adjust the meter to zero with the ZERO ADJUST CONTROL.

(e) Open the leads and adjust the meter to full scale with the OHMS CAPACITY ADJUST control.

(f) Insert the inductance to be measured between the test leads. If the meter reads zero on the X100 MFD scale, the inductance is too small to be measured on the Model TA-2.

(g) Rotate the RANGE switch clockwise until a suitable reading is obtained from the meter. The numerical value of capacity is noted and applied in the formula,

$$L = \frac{7.04}{C} \text{ henries}$$

where C is in MFD. **Note:** This formula is accurate only if the ohmic resistance of the inductance is negligible with respect to the inductive reactance at 60 cycles. The accuracy of calculation is greater than 1% if the product of the ohmic resistance and the capacity reading in MFD. is less than 100 ($RC < 100$)

(h) If the ohmic resistance is appreciable proceed to calculate the inductance as follows:

(1) Read the numerical value of the capacity directly from the scale. Find the associated impedance from the graph given in Figure 5.1. This value is Z_L in the formula below.

(2) Determine the resistance of the inductance by means of the ohmmeter. This value is R_L in the same formula.

(3) Knowing Z_L and R_L the inductance may be calculated from the formula:

$$Z_L^2 = (2\pi fL)^2 + R_L^2$$

where $\pi = 3.1416$
f = line frequency

This formula can be simplified as follows:

$$L^2 = \frac{Z_L^2 - R_L^2}{(2\pi f)^2}$$

if f = 60 cps. then $2\pi f = 377$

Therefore $L = \frac{\sqrt{Z_L^2 - R_L^2}}{377^2}$ henries.

Example of inductance measurement:

R_L is 100 ohms as measured by ohmmeter.

Capacity reading is 8.8 mfd. Therefore Z_L from Figure 5.1 is 300 ohms.

Substituting in the formula.

$$L = \frac{\sqrt{90{,}000 - 10{,}000}}{377^2} = .563 = .75 \text{ henries}$$

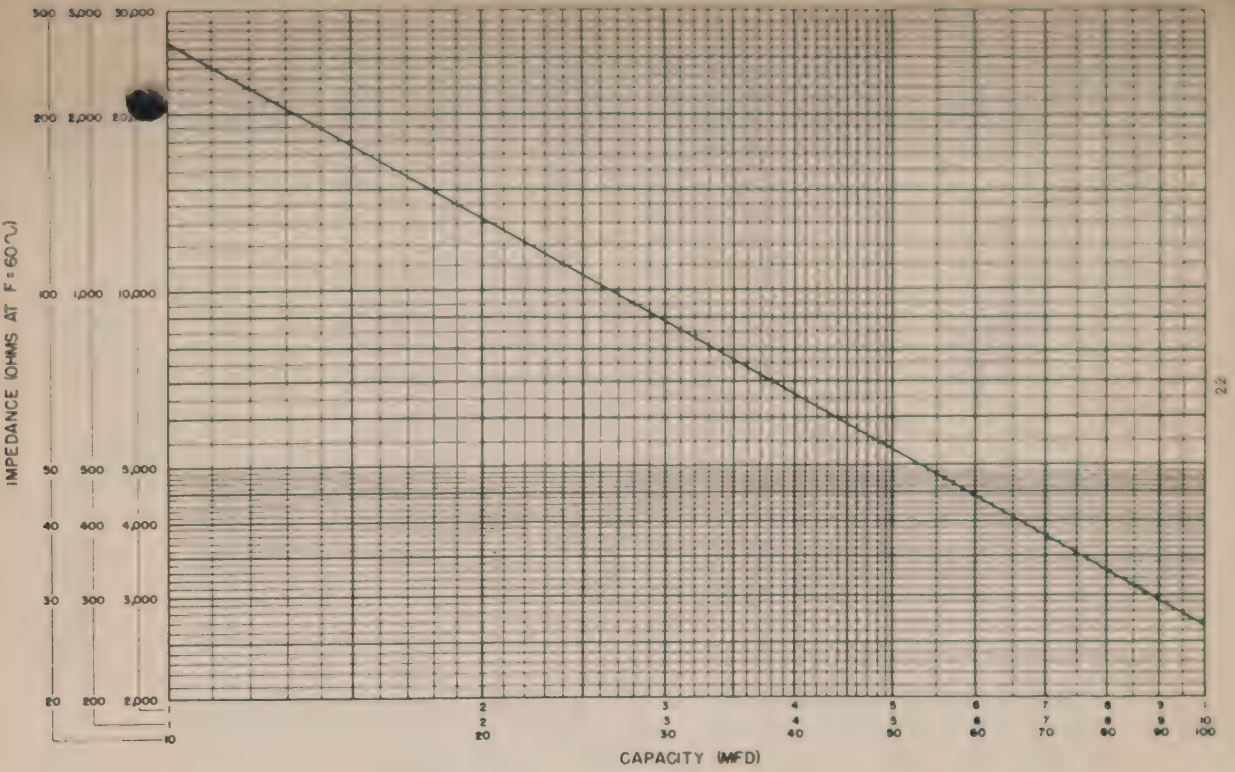


FIGURE 5.1 – IMPEDANCE CHART

4.8 DECIBEL MEASUREMENTS:

(a) The decibel scale can be used to determine the power level based on zero D.B. = 6 M.W. The operation of the Model TA-2 is the same as under paragraph 4.2 A.C. voltage measurements. The ranges used for the various scales are clearly marked on the meter dial.

(b) The following formula can be used to convert the DB reading to watts, provided the reading is taken across a 500 ohm load.

Formula: $$DB = 20 \log. 10 \frac{P}{.006}$$

SECTION 5 – APPLICATION

5.1 GENERAL

The following applications are very general in nature, as it is always advisable to consult the instructions pertinent to the instrument under test to obtain the actual procedure in making a test. The Stark Electronic Volt-ohm Capacity Milliammeter, Model TA-2, may, of course, be used to make all measurements common to an instrument of its type. These applications given here will give more specialized use of which the user may not be aware.

5.2 D.C. VOLTMETER:

(a) **Zero Center or Zero Left:**

The input impedance in the vacuum tube voltmeter is constant at approximately 12 megohms for all ranges. As a result of this high input impedence, it can, in general, be used to measure D.C. voltages in any electrical circuit without appreciably loading down the D.C. circuit and consequently, the voltage as indicated will be essentially the voltage found under normal operating conditions. In the conventional low impedance type of voltmeter the loading caused by the meter is often sufficiently great to cause extreme error when measurements are made in high impedance circuits.

(b) **R. F. and I. F. Circuits:**

As a result of the incorporation of an isolating resistor of 3.3 megohms in the D.C. probe, this voltmeter may be used to measure voltages in oscillating or RF circuits without loading these circuits from a capacitive or resistive standpoint. This feature makes it possible to measure A.C. voltages at such places as the control grids of R.F. and I.F. stages without disturbing the normal operation of those circuits.

(c) **Oscillation Check:**

Another application of the voltmeter is the determination of oscillation or non-oscillation, of the oscillator section of receivers. An immediate check is obtained on the oscillator section by connecting the voltmeter, so as to measure the voltage at the grid of the oscillator tube and tuning from one end of the band to the other. Note the grid voltage throughout the entire range. Normally a negative voltage of from 5 to 30 volts will be found at the grid of the oscillator tube when the oscillator section is operating properly. Dead spots on one or more of the tuning ranges may be located by this test.

(d) **Discriminator Circuit Alignment:**

Service instructions for frequency modulated receivers often call for the insertion of a zero center microammeter in the discriminator circuit. Misalignment is indicated by any reading, either positive or negative, on the meter, and alignment is indicated by a zero reading. The D.C. voltmeter zero center section of the Stark Model TA-2 may be much more conveniently used to make such an alignment. Merely connect it across the discriminator load resistance. Make the necessary adjustment which will bring the meter indication back to the zero center position. Thus a satisfactory alignment can be made without the necessity of breaking the circuit to insert the microammeter.

5.3 A.C. VOLTMETER:

(a) **Normal:**

(1) The A.C. voltmeter impedance has a constant resistive component of approximately 15 megohms shunted by a capacitive component of approximately 6 mmf. The low shunting capacity is obtained by the use of the diode probe and consequently, measurements of voltage over 100 mc. are possible. The range can be extended further by using a braided connection from the ground post of the diode probe to the chassis of the unit under test. This lead should be as short as possible to reduce the possibility of any inductive effect being present along the lead. At high frequencies, the shunt capacity, although it is only 6 mmf, will have a low reactance and may introduce some error in the reading obtained. This error is dependent on the impedance of the source from which the voltage is measured, and increases as the impedance increases. Also at these frequencies the loading imposed by the input capacity may detune a radio frequency circuit.

(2) The A.C. input circuit includes blocking condenser between the test prod and the diode circuit, so that any D.C. components present in the circuit under test are ineffective and only the A.C. components are measured.

(3) When the A.C. voltmeter is used to measure voltages of supply line frequency; for example: the common 60 cycle supply, small discrepancies in the readings may occur if the polarity of the test leads is reversed, this is if the grounded test lead changes in position with respect to the A.C. voltage being measured. The actual voltage in such cases should be taken as the average of the two readings obtained.

(b) **Peak-to-Peak**

(1) The A.C. voltmeter probe has a constant impedance of 15 megohms shunted by approximately 6 mmf. Therefore, the loading will be negligible at lower frequencies. Slight detuning of R.F. circuits under test is to be expected.

(2) The peak-to-peak voltmeter is designed primarily for the study of irregular waveforms in television receivers. Practically all television receiver manufacturers in their service manuals give the necessary data pertaining to peak-to-peak volts of non-sinusoidal waveforms.

(3) The blocking condenser eliminates the D.C. component, and therefore only the A.C. component will be measured.

(4) To have greater accuracy when measuring peak-to-peak voltages between 0 to 12 volts, reference to the chart Figure 4.1 may be made.

(c) **1200 Volts A.C.**

(1) The A.C. voltmeter, 1200 volts A.C. has an input impedance of 3.5 megohms approximately, and is designed for measuring the voltage of power transformers up to 1200 volts. A D.C. path is returned to ground and it should not be used in circuits containing D.C. components unless a blocking condenser is inserted between the binding post and the circuit under test. Be sure the voltage rating of the condenser is equal to or greater than the voltage of the D.C. plus the A.C. voltage being measured.

5.4 OHMMETER

(a) The ohmmeter section of the Model TA-2 uses only 3 volts D.C. for all resistance measurements. Many resistors, especially of the composition type, have what is known as a voltage coefficient; that is, the actual value of the resistance varies as the voltage placed across the resistors. This is especially true of resistance values above one megohm. As an example of this, a resistor measured with 3 volts, as in the model TA-2 to be 5 megohms might differ from 5 megohms if it were measured with several hundred volts. This difference would depend on the voltage coefficient of the resistor.

(b) On the lower ranges the internal shunt resistance between the test

leads, is relatively low in resistance measurements. It is advisable, therefore, never to connect the test leads across a voltage which could possibly damage or destroy these resistors. To avoid this, be sure that the resistor being measured is not connected to an active circuit where measurements are being made.

5.5 CAPACITY MEASUREMENTS:

(a) In conventional capacity measuring devices it is necessary to use very high voltages for measuring capacitors of low capacity with a resultant hazard to the operator. This hazard has been completely eliminated in the model TA-2 and capacity test leads may be handled without fear of electrical shock, as the electronic circuit utilized permits capacity measurements throughout the wide range of approximately 1 mmf to 1000 mfd. with the use of only 6 A.C. Volts.

SECTION 6 – MAINTENANCE

6.1 GENERAL:

As the model TA-2 has been built under the high standards of workmanship of a Stark instrument, no maintenance other than routine replacement of tubes or batteries should be necessary. It is suggested that if the instrument should need maintenance, other than routine replacements, the factory should be contacted with regard to the nature of the trouble, and if necessary, the instrument may be shipped to the factory or to an authorized repair station. A schematic, shown in Figure 7.1 is provided as an aid in maintenance work.

6.2 VACUUM TUBES:

All vacuum tubes are operated at their normal rating, or below to ensure long life and uniform service. To check the tubes remove the chassis from the case by removing the eight screws around the edge of the panel and lifting the panel from the case.

6.3 DRY CELLS:

Two dry cells are operated in series as a source of D.C. in making ohmmeter measurements. If it is impossible to bring the meter to full scale deflection on any scale, it is probable that one or both of the dry cells are low. To replace these, remove the chassis from the case as given in paragraph 6.2 above, and remove the dry cells. First, it will be necessary to remove the clamp holding the cells in place before removing the cells from their clip holders.

NOTE:

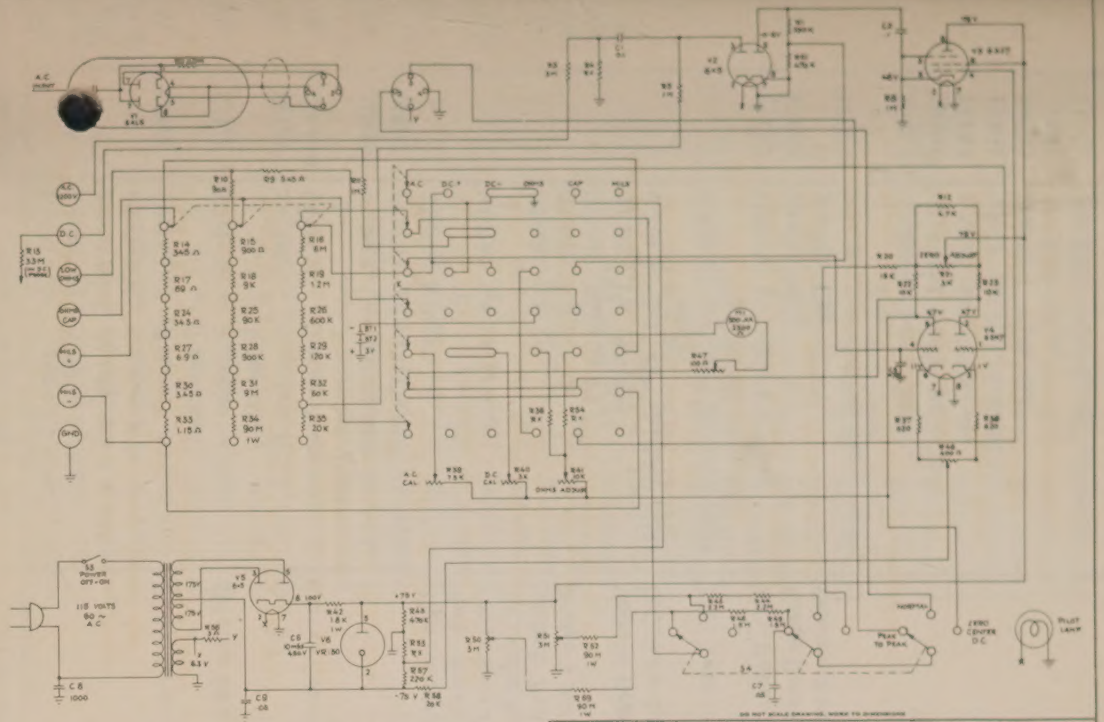
If the meter pointer moves violently to the left with the selector switch in the OHMS position, remove the model TA-2 from its case and check the electrical contacts of batteries BT-1 and BT-2.

SECTION 7 – PARTS LIST
FOR MODEL TA – 2

REF.	PART NO.	NAME AND DESCRIPTION	FUNCTION
BT-1	101A1	BATTERY: 1½ volt unit cell size D	
BT-2	101A1	BATTERY: Same as BT-2	
C1	112L1	CAPACITOR: 0.1 mfd @ 400 v	
C2		CAPACITOR: Same as C1	
C3	112B2	CAPACITOR: .05 mfd @ 400 v	
C5	112D3	CAPACITOR: 470 mmfd @ 500 v mica	
C6	112A9	CAPACITOR: Electrolytic 10 mfd @ 450 v	
C7	112C1	CAPACITOR: .05 mfd @ 400 v	
C8	112D4	CAPACITOR: 1000 mmfd 500 v mica	
C9		CAPACITOR: Same as C7	
M1		METER: Model 606 0-500 Microamps	
R21	134A19	POTENTIOMETER: 3000 ohms	Zero Adjust
R39	134E8	POTENTIOMETER: 7500 ohms	A.C. CAL.
R40	134A12	POTENTIOMETER: 3000 ohms	D.C. CAL.
R41	134B13	POTENTIOMETER: 10,000 ohms	Ohms Cap. Adjust
R50	134C10	POTENTIOMETER: 3 Megohm	Peak-to-Peak Cal.
R51		POTENTIOMETER: Same as R 50	"Normal" Cal.
R1		RESISTOR: 330k ½ W 10%	
R2		RESISTOR: 3.3 megohm ½ W 20%	
R3		RESISTOR: 3 megohm 1 w 1%	
R4		RESISTOR: 1 megohm ½ w 20%	
R5		RESISTOR: Same as R4	
R6		RESISTOR: 470k ½ w 10%	
R8		RESISTOR: Same as R4	
R9		RESISTOR: 9.45 ohms 1% w.w.	
R10		RESISTOR: 90 ohms ½ w 1%	
R11		RESISTOR: Same as R4	
R12		RESISTOR: 4700 ohm ½ w 20%	

REF.	PART NO.	NAME AND DESCRIPTION	FUNCTION
R13		RESISTOR: Same as R2	
R14		RESISTOR: 345 ohm 1% w.w.	
R15		RESISTOR: 900 ohm ½ w 1%	
R16		RESISTOR: 6 megohm 1 w. 1%	
R17		RESISTOR: 69.0 ohm 1% w.w.	
R18		RESISTOR: 9000 ohm ½ w 1%	
R19		RESISTOR: 1.2 megohm ½ w 1%	
R20		RESISTOR: 15000 ohm ½ w 20%	
R22		RESISTOR: 10,000 ohm ½ w 10%	
R23		RESISTOR: Same as R22	
R24		RESISTOR: 34.5 ohm 1% w.w.	
R25		RESISTOR: 90,000 ohms ½ w 1%	
R26		RESISTOR: 600K ½ w 1%	
R27		RESISTOR: 6.9 ohms 1% w.w.	
R28		RESISTOR: 900K ½ w 1%	
R29		RESISTOR: 120K ½ w 1%	
R30		RESISTOR: 3.45 ohms 1% w.w.	
R31		RESISTOR: 9.0 megohm ½ w 1%	
R32		RESISTOR: 60K ½ w 1%	
R33		RESISTOR: 1.15 ohm 1% w.w.	
R34		RESISTOR: 90 megohm 2 w 1%	
R35		RESISTOR: 20,000 ohm ½ w 1%	
R36		RESISTOR: Same as R22	
R37		RESISTOR: 620 ohm ½ w 5%	
R38		RESISTOR: Same as R37	
R42		RESISTOR: 1800 ohm 2 w 10%	
R43		RESISTOR: 2.2 megohm ½ w 20%	
R44		RESISTOR: Same as R43	
R45		RESISTOR: Same as R6	
R46		RESISTOR: 400 ohm Semi-adjust	CAL.
R47		RESISTOR: 100 ohm Semi-adjust	CAL.
R48		RESISTOR: 1.5 megohm ½ w 20%	
R49		RESISTOR: Same as R48	
R52		RESISTOR: Same as R34	
R53		RESISTOR: 2200 ohms ½ w 20%	
R54		RESISTOR: 5600 ohms ½ w 20%	

REF.	PART NO.	NAME AND DESCRIPTION	FUNCTION
R56		RESISTOR: 3 ohms 1% w.w.	
R57		RESISTOR: 220K ½ w 20%	
R58		RESISTOR: 20,000 ohm ½ w 10%	
R59		RESISTOR: Same as R34	
S1	144J2	SWITCH: Rotary 5 section 7 position	Range Switch
S2	144J1	SWITCH: Rotary 4 section 8 position	Selector Switch
S3	144A9	SWITCH: Toggle S.P.S.T.	On-off
S4	144A10	SWITCH: Rotary 1 section 3 position 1 pole	Circuit Selector
T1	148H1	POWER TRANSFORMER 60 cycle	
	148H2	POWER TRANSFORMER 25 cycle	
V1		TUBE: 6 AL5	High Frequency Probe Rectifier
V2		TUBE: 6 x 5 GT/G	Power Rectifier and A.C. volts Rectifier
V3		TUBE: 6 S J 7	Cathode Follower
V4		TUBE: 6 S N 7/Gt	Bridge Tube
V5		TUBE: Same as V2	
V6		TUBE: VR 150-OD3	Voltage Regulator
		CABLE: D.C. 48" Shielded cable ass'y.	D.C. Test Lead
		CABLE: A.C. 48" Shielded cable and Probe assembly	A.C. Test Lead
	111A1	CORD: A.C. line 8 ft. long	A.C. Power Line
	121C9	KNOB: Skirt	Range Control and Selector Switch
		KNOB: Cap	
	121C11	KNOB: Cap with pointer or white dot	
	103L1	BINDING POST RED	
	103M1	BINDING POST BLACK	
	131A2	LAMP –6–8V G.E. #44	
	151G1	TEST LEAD ASSEMBLY	
	140E3	SOCKET 7 pin min.	
	140E1	SOCKET Octal	
	131C1	SOCKET Pilot Lamp, red jewel	



R? = EXACT VALUES DETERMINED IN PRODUCTION
R4 - 1MEG APPROX
R38 - 10K APPROX
R54 - 2.2K APPROX
K = 1000 Ω
M = 1,000,000 Ω
ALL RESISTORS ½ WATT UNLESS OTHERWISE NOTED

DO NOT SCALE DRAWING, WORK TO DIMENSIONS

ALT	REVISION	BY	DATE	APP'D

DRWN ON	MODEL TA2
MATERIAL	
NO. OF PCS/FT	BLACK
FINISH	
PART NO.	
TOLERANCES: FRACTIONS ±	
DECIMALS ±	
ANGLES ±	

STARK ELECTRONIC INSTRUMENTS LTD.
TORONTO, CANADA

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CHK'D	APPROVED	DATE	SCALE
			PART NUMBER
APVD			100 - 626

WHEN REFERRING TO THIS DRAWING, STATE DRAWING NUMBER AND ALTERATION LETTER

STARK TUBE TESTERS:

Model 9-11A—Portable "Three Control" Tube Tester.

Model 9-56—Tube Merchandiser, with Battery and Continuity Tests.

Model 9-66—Dynamic Mutual Conductance Tube Tester.

STARK ANALYZERS:

Model AF-2—DC 1000 Ohms per Volt, Pocket Size Volt-Ohm Milliammeter.

Model SD-1—AC & DC 5,000 Ohms per Volt, Pocket Size Volt-Ohm-Milliammeter.

Model ES-1—AC & DC 20,000 Ohms per Volt, Open Face Analyzer.

Model KM—AC & DC 20,000 Ohms per Volt, Deluxe Analyzer.

Model 460—AC & DC 20,000 Ohms per Volt, Rugged Analyzer.

Model TA-2—Electronic Volt-Ohm-Milliammeter (Vacuum Tube) Analyzer.

Model VT-9—Electronic Volt-Ohm-Milliammeter (Vacuum Tube) Analyzer (Large Size).

STARK SIGNAL GENERATORS:

Model 10-A—R.F. Signal Generator, 95 K.C. to 144 M.C.

STARK CATHODE RAY OSCILLOSCOPES:

Model OS-9—5" With Internal FM Generator.

Model 115 —5" Unitized Construction C-RO.

TELEVISION ALIGNMENT:

Model 610A—Universal Television Alignment Signal Generator.

Model 690 —UHF-VHF Marker Oscillator.

Model 691 —Hetrodyned Marker Adder.

Model 695 —VHF Sweep Generator.

Model 697 —UHF Sweep Generator.

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